SustainaBlue

HEIs stands for Higher Education Institutions

HEIs for Sustainable Blue Economy in Malaysia and Indonesia

SustainaBlue

D2.3 Recommendations for the effective adaptation/replication of Quintuple Helix models/practices

ERASMUS Lump Sum Grants

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symplexis

Supporting Malaysian and Indonesian HEIs to boost their relevance to the labor market and society for a sustainable blue economy and green transition

PROJECT PARTNERS:

Malaysia

UNIVERSITI MALAYSIA TERENGGANU

UNIVERSITI SAINS MALAYSIA

MALAYSIA AQUACULTURE DEVELOPMENT ASSOCIATION

Indonesia

UNIVERSITY OF INDONESIA

INSTITUT TEKNOLOGI SEPULUH NOPEMBER

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Document Identification:

Work Package	2. Establishment and operation of Sustainable Blue Economy Centres for collaboration with blue industries, local authorities and other stakeholders
Task	2.1 Collection of successful Quintuple Helix frameworks/models from the partner EU MSs and/or other EU MSs, assessment of their transferability to the Asian context, and elaboration of recommendations for effective adaptation/replication
Deliverable title	D2.3 Recommendations for the effective adaptation/replication of Quintuple Helix models/practices
Lead Partner	Symplexis
Author(s)	Symplexis, UCY
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Abstract	The current document presents recommendations for adapting successful European Quintuple Helix models to Malaysia and Indonesia for a sustainable blue economy. It explores best practices from Greece and Cyprus, addressing their potential replication, local adaptation, and the challenges involved.
Status	Final
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1. Introduction

The present set of recommendations for the successful adaptation/replication of successful Quintuple Helix models and practices in blue economy from the EU to the Asian context was created as part of "SustainaBlue", a three-year-long Capacity Building for Higher Education project realised with the financial support of the Erasmus+ programme of the EU. This set of recommendations is a direct outcome of the initial mapping activities carried out the project's EU partners (AR, UAEGEAN, SYMPLEXIS, UCY, CSI) during the first months of its implementation, which initially led to the identification of the most successful Quintuple Helix practices in Greece and Cyprus (D2.2). Subsequently, the present document seeks to explore how these practices can be adapted to the Asian context and needs, specifically in Malaysia and Indonesia.

1.1. The SustainaBlue project

With regards to the current project, SustainaBlue aims to support Malaysian and Indonesian Higher Education Institutions (HEIs) in boosting their relevance to the labour market and society for a sustainable blue economy and green transition. The term "**Blue Economy**" refers to the sustainable use of aquatic resources for economic growth, to the improvement of human well-being and social equity, and to the protection against negative environmental externalities, such as pollution and climate change. To achieve a green transition, all blue economy sectors, including fisheries, aquaculture, coastal tourism, marine transport, port operations, and shipbuilding, must work together to lessen their environmental and climate effect. This shift to a more sustainable blue, circular, and carbon-neutral economy will generate new employment and enterprises.

The project aims to directly and indirectly benefit HEIs staff and students, blue industries, and the local communities. More specifically, the project aims towards:

1. Strengthening the skills of HEIs teaching staff on curriculum development, teaching methods, and content on the next generation of blue skills.
2. Improving the capacities of HEIs' staff on active cooperation with stakeholders (i.e., Quintuple Helix, see sections below).
3. Strengthening the cooperation of HEIs with the industry and other stakeholders, to address mismatches between the requirements of employers and the offer of HEIs, and to promote the Quintuple Helix innovation (Industry-Government- Public and Civil Society-Environment).
4. Modernising the academic offer of HEIs towards a sustainable blue economy.

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5. Transferring of HEIs teaching and/or research results to the local coastal communities.
6. Improving the level of skills and employability potential of students in the sustainable blue economy.
7. Enhancing the reskilling and/or upskilling of the active labour force in the blue industries on the next generation of blue skills.
8. Raising awareness among students, especially women, on "sustainable blue careers".

SustainaBlue is being funded by the European Union & the EUROPEAN EDUCATION AND CULTURE EXECUTIVE AGENCY (EACEA), under the Erasmus LS Capacity Building in Higher Education programme, and spans from 01/12/2023 to 30/11/2026.

1.2. Overview and scope of the present document

The present document, containing a set of recommendations for the adaptation of successful EU Quintuple Helix practices in Malaysia & Indonesia, has been created within the scope of the project's 2nd Work Package (WP), "Establishment and operation of Sustainable Blue Economy Centres for collaboration with blue industries, local authorities and other stakeholders". In order to address mismatches between employer requirements and HEI offerings, this WP seeks to:

a) strengthen HEI administrative and teaching staff's capacities for active cooperation with stakeholders (the Quintuple Helix),
b) strengthen HEI collaboration with industry and other stakeholders,
c) advance Quintuple Helix innovation (Industry-Government-Public and Civil Society-Environment), and
d) transfer HEI teaching and/or research results to the local coastal communities, thereby generating social value.

Thus, this document aims to provide the four Asian HEIs (UMT, USM, UI, ITS) with a collection of suggestions and recommendations on how they can adapt and replicate successful Quintuple Helix practices to fit their contexts and situation. After having identified and collected these best practices in blue economy, the Greek and Cypriot partners from Symplexis and the University of Cyprus, with the help and consultation on behalf of the Asian partners, set out to elaborate how they can be adapted and adjusted by the latter and what factors need to be in place for their effective adoption. This set of recommendations will ultimately contribute to the establishment and set-up of the four "Sustainable Blue Economy Centres" in each of the partner HEIs in Malaysia and Indonesia.

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The Sustainable Blue Economy Centres will provide a range of services that foster the development of internal and external stakeholders, with the aim of bolstering research activities, fostering innovation, and enhancing research capacities. Within the context of the blue economy, the Centres will seek to carry out extensive education and awareness campaigns on maritime and coastal areas. This includes providing seminars and courses, planning public outreach events, carrying out research, promoting sustainable policies, enticing community engagement, and forming alliances and working together with different blue economy players. The Centres will aim to develop work that meets worldwide standards of quality and is competitive on a global scale.

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2. The Quintuple Helix Innovation Framework

The Quintuple Helix Model, which the current project seeks to apply throughout its activities, visualizes the importance of collectivity and exchange along with the education, the economy, the environment, the society, and the political systems. A characteristic feature of the model is its orientation towards a new kind of cooperation, co-creation and co-production of knowledge, which takes place within a regional innovation system in the context of sustainable development principles, where the issues of environmental protection are a focal point of reference for the designed solutions.

Through organised cooperation between academic institutions in Malaysia and Indonesia, the blue economy sector, and other pertinent stakeholders, SustainaBlue seeks to address market gaps with curriculum, research, and innovation that take into account ongoing technological advancements as well as the needs and challenges of regional communities and the environment. It becomes, thus, evident why the Quintuple Helix Innovation Model is a perfect fit for the project's scope and objectives, since it constitutes a theoretical and practical paradigm for the flow of knowledge between the five helices with the goal of promoting sustainable development for society at large.

More specifically, the Quintuple Helix innovation model proposes that there are five sub-systems/helices, which impact each other, with the information input in one of them having a cascading effect on the others. According to Carayannis & Campbell (2010), these five helices include the education system, the economic system, the natural environment, the media- and culture-based public (civil society), and the political system. Carayannis, Barth, & Campbell (2012, p. 5-6) maintain that each of these 5 sub-systems/helices has a specific function and relevance:

a. The **education system**, which defines itself in reference to 'academia', 'universities', 'higher education systems', and schools. In this helix, the necessary 'human capital' (for example students, teachers, scientists/researchers, academic entrepreneurs, etc.) of a state is being formed by diffusion and research of knowledge.
b. The **economic system**, which consists of 'industry/industries', 'firms', services, and banks. This helix concentrates and focuses on the 'economic capital' (for example: entrepreneurship, machines, products, technology, money, etc.) of a state.
c. The **political system**, which formulates the 'will', where the state is heading toward in the present and future, thereby also defining, organizing as well as administering the general

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conditions of the state. Therefore, this helix has a 'political and legal capital' (for example: ideas, laws, plans, politicians, etc.).

d. The **media-based and culture-based public** integrates and combines two forms of 'capital'; On the one hand, this helix has, through the culture-based public (for example: tradition, values, etc.), a 'social capital'. On the other hand, the helix of media-based public (for example: television, internet, newspapers, etc.) contains also 'capital of information' (for example: news, communication, social networks).
e. The **natural environment** is decisive for sustainable development and provides people with a 'natural capital' (for example: resources, plants, variety of animals, etc.).

The Quintuple Helix model emphasises the required socioecological transformation of society and economy, which will open the door for the development of green and blue knowledge and innovation, whereas the natural settings of society and the economy are also considered as drivers for knowledge creation and innovation. Thus, *the Quintuple Helix promotes the development of a win-win scenario which incorporates ecology, knowledge, and innovation, fostering connections across the democratic, social, and economic spheres*.

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3. Overview of the best Quintuple Helix practices identified

During the first months of the SustainaBlue project, a preliminary desk and field research was conducted by the EU partners (AR, CSI, Symplexis, UAegean, UCY), with the aim of pinpointing successful Quintuple Helix practices and models in the blue economy of Europe, and specifically in Greece and Cyprus. In this section, we will briefly discuss these identified practices, their specifics, their strengths and weaknesses, in order to examine their adaptability/replication potential in the Asian context (see next section).

After consulting with the Asian HEIs (UMT, USM, UI, ITS), the following practices were found to be the most interesting and potentially adaptable in their local and national contexts:

a) The Marine and Environmental Research (MER) Lab in Cyprus

MER (https://www.merresearch.com/) is a small-medium enterprise (SME) made up of marine scientists, and it aims to provide specialist marine and environmental research and consulting services, while also serving as a government advisor and liaising with fishing sector stakeholders, divers, and other marine users. With a wide range of field tools, its team undertakes underwater surveys, sampling, and monitoring of physical, chemical, and biological parameters in both water columns and benthic settings. The Lab's facilities are designed for the gathering, analysis, and processing of biotic and abiotic data, essential for marine environmental monitoring and research. MER has carried out several projects and research activities around the coastal and offshore areas of Cyprus, focusing on marine biological ecology, aquaculture, and fisheries.

MER encompasses the Quintuple Helix innovation model, by bringing together the educational, economic, political, media, and environmental systems. More specifically, by using its experts' excellent scientific knowledge and teaching abilities, MER provides educational content and field trips (e.g., boat excursions, diving, snorkelling) suited to groups interested in learning more about marine ecosystems and the human effects on them, while also collaborating with universities in dissertation and training programmes.

Moreover, MER utilises its social media and networks' reach to widely promote its activities and initiatives. MER provides a range of services (serving a variety of development interests, including ports, harbours, marinas, power plants, desalination plants, hatchery units, and real estate developers) to determine and promote sustainable practices in coastal management and development, being able to influence the authorities towards promoting the blue economy of the island thanks to its position as a

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governmental consultant. Ecology is one of the key areas of specialisation at MER, with the team consisting of marine ecologists and biodiversity specialists involved in environmental assessment activities through studies to guarantee that the environmental consequences of choices are evaluated before they are implemented.

MER can be regarded as one of the most significant research centres in Cyprus aiming to advance the blue economy through the wide range of services it provides, such as the implementation of marine research programmes, the evaluation of the region's environmental impact, the monitoring of sea ecosystems, and the promotion of marine ecology and biodiversity.

b) The Blue Municipalities Network (BMN) in Greece

The Blue Municipalities Network (BMN) (www.bluemunicipalities.org) constitutes a forum for coastal municipalities, including the "Committee of Mayors" that determine the network's overarching goals and agenda, aiming to address the challenges related to the maritime environment, offering leadership, strategic direction, and decision-making power. The "Technical Team," which is also part of the BMN, provides technical assistance and knowledge for organising, carrying out, and overseeing projects related to the preservation of the maritime environment, ensuring that they are grounded on best practices and solid scientific principles.

A wide spectrum of stakeholders, including presidents of port authorities, mayors and deputy mayors, representatives from universities, research facilities, the fishing industry, government ministries, and civil society groups are part of the network, guaranteeing that different viewpoints and levels of experience are taken into account when formulating and carrying out decisions.

The BMN's educational programmes and seminars are essential for community involvement and maritime environmental conservation, while the Marine Litter Stations established not only aid in the reduction of marine pollution, but also foster economic growth by generating value from waste products. Gaining access to scientific information to support policy choices is made possible through the BMN's collaboration with research organisations, academic institutions, and other specialists.

By recognising the significance of the blue economy, BMN helps local authorities and communities acknowledge the potential for economic development and job creation, whereas the engagement of the private sector improves the efficacy and scalability of programmes by contributing extra financing, technology solutions, and business skills. In order to empower local communities and have an impact on national and local policymaking, the BMN gives local communities a forum to actively engage in

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conversations and decision-making processes around maritime environmental challenges, by bringing together over 20 municipalities and cooperating with the Central Union of Municipalities in Greece.

The BMN is also a prime example of environmental democracy, providing volunteers and local communities with the tools to actively participate in fieldwork and evidence-based policymaking; thus, it guarantees open, inclusive, and locally focused decision-making processes by incorporating stakeholders at the grassroots level. The BMN also organises frequent clean-up initiatives, which are essential for increasing public awareness and inspiring action among communities, in addition to cleaning up coastal and marine regions. People who take part in cleanup projects frequently have a stronger sense of connection to their environment and an increased desire to preserve these priceless natural surroundings, leading to long-term behavioural adjustments like trash reduction and the adoption of more environmentally friendly daily routines.

In general, the BMN facilitates communication, cooperation, and action for the preservation of the maritime environment by acting as a link between regional communities, governmental organisations, educational institutions, and other stakeholders. The active engagement of all important stakeholders reflects an understanding of the value of multidisciplinary collaboration in addressing environmental concerns and helps create best practices and new ideas for efficiently addressing marine pollution. Overall, the network exemplifies environmental democracy in action, demonstrating how collaboration among government, academics, the commercial sector, and local communities can result in significant environmental conservation and sustainable development benefits.

c) PROJECT MARRE - MARine monitoring system of the Hellenic Seas using REmote sensing satellite data and in-situ measurements

Project MARRE (www.marre.gr) creates novel solutions to monitor the state of the maritime environment using freely available satellite observation data, providing water quality data based on in-situ measurements. The combination of satellite data with in-situ measurements tests and enhances existing empirical techniques. Consequently, the generated products are tailored to local circumstances and the unique characteristics of Greek waters. Marine biodiversity monitoring has been prioritised through the mapping and monitoring of the Posidonia oceanica meadows, using Chl-a maps, Total Suspended Matter (TSM) maps – Turbidity, Posidonia oceanica maps, and Potential Fishing Zone maps.

We also observe the interplay between the five Helices in this project as well. Mapping fishing zones necessitates an understanding of marine ecosystems, including habitats, currents, and species

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distribution; this technique teaches pupils about the interdependence of different marine components and how they sustain one another. On the other hand, expanded market access, optimised fishing efforts, less resource waste, increased safety, and more educated management choices all contribute to more lucrative and sustainable fishing methods. Fisheries governance may utilise this data to put specific conservation measures into place, such as creating marine protected areas or restricting fishing in particular regions to avoid overfishing, whereas researchers can use them to examine fish behaviour, preferred habitats, and ecosystem dynamics, which can in turn help them make better decisions and implement more successful conservation plans.

Subsequently, the mapping of fishing zones raises public awareness about the effects that fishing has on the ecosystem, sustainable practices, and the significance of preserving marine biodiversity. Last but not least, the project can have a positive impact on the natural environment, through sustainable resource management, ecosystem conservation, reduced bycatch, minimised habitat destruction, improved monitoring and enforcement, support for scientific research, and resilience to climate change, assisting in the preservation of marine biodiversity, the protection of delicate ecosystems, and the regulation of fishing operations, eventually improving the overall state of our seas.

Through the implementation of the MARRE project, fishermen may gain a competitive edge in the market, if they have access to comprehensive maps of fishing zones. Furthermore, certain customers could prefer products branded with details on the location and method of fish capture, opening doors for premium branding and market distinction.

d) PROJECT AQUASAFE - Towards a precision aquaculture geoinformation system in Greece

The project's (www.aquasafe.gr) goal was to develop an integrated geoinformatics system for aquaculture that would allow for remote monitoring and early warning. The development of a geoinformation system for aquaculture monitoring that combines historical and real-time field data with high resolution optical and radar satellite data is regarded as an inventive concept that will help generate new knowledge on a national and worldwide scale. The system created will notify the aquaculture management of occurrences (e.g., development of harmful algal blooms, jellyfish blooms and transfer of pathogenic microorganisms and nutrients) that might directly or indirectly endanger aquaculture.

The aquaculture geoinformation system's primary goals are:

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1) to use a biological prediction model to predict food growth and consumption as well as oxygen requirements;
2) to establish a model to measure environmental parameters in the field using smart devices (the internet of things) connected in multiple units;
3) to use satellite systems for remote observation and monitoring of environmental parameters;
4) to develop early warning models; and
5) to develop a geoinformatics system for tracking and early warning.

Precision aquaculture maximises production processes via the use of sensors, automation, and real-time monitoring systems. This increases yields, improves resource efficiency, and boosts profitability. Aquaculture owners may receive training on how to use the platform to increase their production. Moreover, precision aquaculture has the power to influence political agendas, improve governance, and bring about beneficial change for the environment. This can include achieving sustainable development goals, enhancing food security, and stimulating economic growth.

The value of aquaculture lies in its capacity to protect traditional fishing methods and cultural heritage; indicatively, fishing is not just an economic activity, but also a deeply rooted cultural heritage that has been passed down through the centuries in many coastal towns and indigenous nations. Through the optimisation of production efficiency, precision aquaculture mitigates the strain on wild fish populations. With the increasing demand for seafood worldwide, this sustainable approach offers a practical substitute for conventional fishing methods, supporting the preservation of marine biodiversity.

Aquaculture techniques are being revolutionised by automation, sensors, and data analytics. Indicatively, robots help with labour-intensive jobs like feeding and monitoring, thus increasing productivity, while farmers are empowered to improve conditions for fish health through real-time monitoring of water quality metrics made possible by the integration of sensors and IoT devices. Systems for remote monitoring enable supervision from any location, guaranteeing prompt reactions to crises. Aquaculture might be reshaped by these technological advancements, and projects and initiatives that take advantage of them, such as the project AQUASAFE, will find themselves at the forefront of progress.

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e) PROJECT MSP 2 (ΘΑΛ-ΧΩΡ 2) - Cross-border Cooperation for Maritime Spatial Planning

MSP2 (https://www.mspcygr2.info/) aimed to further develop the implementation methodology used in MSP1 and apply it in preparing spatial plans for selected marine areas in Cyprus and Greece. In this context, the project recorded the current situation through the collection of data and other information relating to maritime human activities and the environment. Furthermore, the project set priorities and objectives and analysed the forecasted future situation, both to further develop existing activities and to develop new ones, at the same time ensuring a desirable environmental situation. Bearing in mind that ecosystems and the impact of marine and coastal human activity go beyond national borders, the project partners developed a joint strategic proposal to ensure environmental sustainability.

MSP 2 established in 2021 of a Policy Statement on Maritime Spatial Planning for Cyprus, setting its vision, priorities, goals and strategic guidelines for the sustainable growth of its Blue Economy. As the main deliverable of MSP 2 (coordinated by the Cyprus Shipping Deputy Ministry), Cyprus established its first Maritime Spatial Plan in 2023, aiming to facilitate the sustainable exploitation and growth of its marine waters, focusing on the Blue Economy sectors of fisheries, aquaculture, energy (including offshore renewable energy), maritime and coastal tourism, shipping and ports, as well as promoting cultural heritage and the scientific research and knowledge.

f) Project BLUEMED – Plan/Test/Coordinate Underwater Museums, Diving Parks and Knowledge Awareness Centres

The main objectives of the BLUEMED project (http://www.bluemed-initiative.eu/the-project/) were the protection and conservation of the underwater natural and cultural heritage in coastal and adjacent maritime regions of the Mediterranean and the strengthening of the economy of these areas by promoting and adopting a model of sustainable and responsible tourism development. Specifically, the programme aimed towards the proper exploitation and protection of underwater natural and cultural heritage through the correct design, control and coordination of Underwater Museums, Diving Parks and Knowledge Awareness Centres.

BLUEMED applied common methodologies in order to:

i) address the priorities of the European Strategy for more Growth and Jobs in Coastal and Maritime tourism;

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ii) integrate principles of the EU Protocol on Integrated Coastal Zone Management, the Maritime Spatial Planning Directive, and the Mediterranean Strategy for Sustainable Development

iii) help preserve and protect underwater cultural resources in situ by leveraging the implementation of the Convention on the Protection of the Underwater Cultural Heritage;

iv) assist the Biodiversity and Adaptation EU strategies in minimizing impact to marine ecosystems and help selected sites adapt to climate change.

The project produced diversified and competitive tourism products with distinct local characteristics by adopting a 'place-based' approach.

g) MUSAN – Museum of Underwater Sculpture, Ayia Napa

The Municipality of Ayia Napa in Cyprus along with The Department of Fisheries and Marine Research (Ministry of Agriculture, Rural Development and the Environment) designed and completed the project of creating the Museum of Underwater Sculpture in Ayia Napa (https://musan.com.cy/), envisioning a space where art and nature harmonize. Over 90 submerged artworks made from inert, pH neutral materials are exhibited at varying depths, designed for both diving and snorkelling. MUSAN has been designated by a Ministerial decree as one of the 6 Marine Protected Areas with Artificial Reefs, aiming to enhance fish stocks and safeguard the marine environment.

h) The Underwater Museum of Alonissos – Blue Med Interreg Programme

One of the largest shipwrecks from the Classical era, measuring ten meters broad by thirty meters long, able to bear about three thousand amphorae, is housed in the Alonissos Underwater Exhibition. It was discovered in 1985 by Dimitris Mavrikis, dated from around 425 to 420 B.C. The Underwater Museum is the first of its kind in Greece open to the public. Since its August 2020 debut, recreational divers have been able to explore it during the summer. The vessel is of uttermost importance to archaeology because of the number of intact findings, dubbed as "The Parthenon of Shipwrecks".

The NOUS Undersea Vision Surveillance System's successful installation and technical advancements make it feasible for this museum to operate. Five NOUS submarine units, each with a camera and windscreen wipers attached to the camera lenses, make up Peristera's system. Multitasking processing units are in charge of the underwater operation. The network of underwater cameras, which extends to a submerged hub, is powered by a 200-meter cable that reaches to the beach and is connected to a

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specially constructed solar power station at Peristera. A 360-degree capable remotely operated camera and an upgraded weather station are also included in the Peristera NOUS setup for monitoring the sea and land. Through a built-in internet connection and fibre optic and radio frequency communication, the Peristera NOUS system sends data from the NOUS water unit to a cloud server. A groundbreaking achievement in underwater technical engineering, the full-scale deployment of the Peristera NOUS setup demonstrates the potential power of NOUS.

The Underwater Museum of Alonissos (https://museum.alonissos.gov.gr/en/about/) is an excellent example of the interplay between the five elements of the Quintuple Helix model. Firstly, the museum offers education on aquatic habitats, preserved artefacts, and submerged history. Through experiential learning and instructional initiatives, students acquire multidisciplinary expertise and a heightened understanding of the importance of marine conservation efforts, fostering appreciation for undersea cultural heritage. Secondly, underwater museums boost local economy by promoting tourism; travellers spend money on lodging, food, travel, and leisure pursuits, promoting economic development in the areas around them. Furthermore, employment possibilities for dive guides, archaeologists, museum workers, and support staff are frequently generated by underwater museums. Thirdly, underwater museums require political participation in the form of financial backing, regulatory supervision, legal agreements, and stakeholder cooperation to preserve the underwater cultural heritage.

Moreover, negotiating complicated legal frameworks, including international accords like UNESCO's Convention on the Protection of the Underwater Cultural Heritage, is often necessary for the development of underwater museums. Fourthly, underwater museums that include the cultural system demonstrate a comprehensive approach to preserving cultural history, acknowledging the interdependence of culture, environment, and society, inspiring stewardship for the future while enhancing our collective understanding of the past via their inventive fusion of art, history, and marine science. Last but not least, these museums frequently serve as man-made reefs, fostering biodiversity and offering homes for aquatic life. Underwater ecosystems are restored and enhanced as a result of the corals, sponges, and other marine animals that eventually cling to the submerged structures. Through the integration of adaptation techniques with cultural preservation initiatives, these museums enhance the resilience of coastal communities and historical monuments.

A prominent pattern propelling the establishment of underwater museums is the aspiration to preserve and present submerged cultural treasures. Beneath the waves, several historical relics and archaeological sites are exposed to environmental harm, theft, and deterioration. These priceless

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artefacts from human history are not only conserved but also made innovatively and immersively available to the public through the establishment of underwater museums.

i) Aegean Rebreath (AR)

In 2017, a small group of concerned citizens came together to form Aegean Rebreath (www.aegeanrebreath.org), with the goal of protecting the coastal and marine environment. Aegean Rebreath employs a comprehensive circular economy model to address marine ecosystem degradation, according to the ideals of environmental democracy and intergenerational fairness. Communities are engaged in six important areas:

- Clean Ups: Since 2017, more than 90 undersea and coastal clean-ups have taken place, with more than 150 tonnes of marine trash having been cleared by more than 100 volunteer divers.
- Recycle the Seas: AR has created Europe's first Marine Litter Stations Network, serving as hubs for teaching and awareness-raising.
- Established Network: In 2021, AR established the first "Blue" Municipalities Network in Greece based on cooperation treaties with the municipalities having had Marine Litter Collection Stations installed. 18 member municipalities in Greece make up the Network today, which obtained a legal entity in 2023.
- Research to Rebuild: So far, AR has created a database that records data on 217 materials gathered throughout the execution of projects in 45 Greek locations, as well as data from studies on microplastics and seawater quality.
- Creation of pilot projects: In collaboration with private organisations, AR creates pilot research projects that provide crucial primary data and significantly aid in the formulation of policies based on applicable UN Sustainable Development Goals and ESG standards.

Aegean Rebreath is dedicated to designing and implementing its activities based on the Quintuple Helix Innovation Model. More specifically, with regards to the education system, AR strives to foster a feeling of environmental stewardship and promote positive change towards a more sustainable future through educational programs and group activities. The instructional strategy takes a methodical approach intended to fully immerse students in the complexities of marine pollution and aid in their understanding of its origins and effects, while also hosting seminars for employees and community members, which function as forums for discussion and cooperation to inspire communities to embrace sustainable practices.

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With regards to the economic system, AR is dedicated to spreading the word that sustainable practices and economic growth are inextricably connected through strategic relationships with private companies and international organisations, having involved businesses in innovative pilot programmes meant to increase public awareness of environmental challenges and spur constructive change. In addition, AR has built the first network of marine trash collection stations, demonstrating to nearby communities the advantages and tenets of a circular economy. Through promoting partnerships with private companies and global organisations, AR aims to promote systemic change towards a more sustainable future in which environmental preservation and economic development coexist.

With respect to the political system, Aegean Rebreath has established bilateral memoranda of cooperation with many local authorities to promote sustainable practices and protect the maritime environment. By working together with local government representatives, the development of tangible action plans intended to tackle urgent environmental issues is facilitated.

Furthermore, with respect to the media-based and culture-based public, AR actively involves nearby communities, enabling them to take part in the monitoring of the maritime environment's quality and grassroots advocacy for change. AR reaches a variety of audiences by disseminating its practices and messages globally, encouraging people and communities all around the world to participate in preserving ocean life.

Lastly, with regards to the natural environment, AR is deeply devoted to protecting the maritime environment; its efforts have resulted in notable advancements in the areas of marine ecosystem restoration, prevention, and depollution. For example, AR aims to lessen the detrimental effects of marine litter on marine life and coastal environments by putting into practice efficient trash management and cleaning procedures.

Aegean Rebreath signals the emergence of environmental democracy in Greece, highlighting the critical need to protect the maritime environment. AR brought attention to the problem of marine degradation that had previously gone unnoticed by local communities and municipal authorities through its institutional and operational efforts. Today, AR acts as a hub, coordinating cooperative efforts between municipalities, federal agencies, private businesses, and communities. In unison, they endeavour to formulate and execute focused measures with the objective of fostering and conserving the aquatic ecosystem for future generations.

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4. Recommendations for their successful adaptation in Malaysia and Indonesia

Most of the identified practices and initiatives could be possibly adapted and replicated in different contexts. Examples such as the successful tourist model of Cyprus, could be enhanced in Malaysia and Indonesia and made more sustainable. The shipping models of Greece and Cyprus, which are world leaders in marine transportation, could be investigated for their transferability potential in the Asian context. Other possible practices that could be adapted include the sectors of Blue Economy that are connected to innovation, as well as the creation of Centres of Excellence based on the model of CMMI (Cyprus Marine and Maritime Institute), with the potential of bringing together all sectors of the blue economy under one roof and ensuring ensure interdisciplinary research and innovation, bridging the gap between industry and research community.

Following consultations with partners in Malaysia and Indonesia, certain blue economy practices based on the Quintuple Helix innovation models have been selected that could be successfully replicated to their national context. The practices that stood out are the following:

1. **Blue Municipalities Network (BMN)**, a network for coastal municipalities, which demonstrates how the collaboration among government, academics, the commercial sector, and local communities can result in significant environmental conservation and sustainable development benefits. Through cooperation amongst many stakeholders, the Blue Municipalities Network (BMN) seems to be a viable effort aiming at encouraging sustainable practices for the maritime environment. In order to ensure that interventions are relevant and successful, to generate grassroots support, and to encourage ownership, it is imperative that local communities be actively involved. The idea of coastal municipalities coming together to provide strategic direction, leadership, and decision-making is attractive in the national context of the Asian countries, given that in the context of this practice, the municipalities form "Technical Teams" that ensure the successful collaboration between neighbouring municipalities. This is vital for all involved municipalities' effective communication and collaboration in addressing blue economy related issues. Partnerships and cooperation with pertinent stakeholders should continue to be a top focus in order to use the BMN's experiences and accomplishments to spur comparable practices at the Asian level.
2. **Project AQUASAFE**, which integrates a geoinformatics system for aquaculture, allowing for remote monitoring and early warning of occurrences that could endanger aquaculture (i.e.,

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harmful algal blooms, jellyfish blooms, etc.). The development of a geoinformatics system for aquaculture that integrates historical, in situ field data, and satellite data can help generate new knowledge on a national and worldwide scale. The technology and applications of remote sensing are new to Malaysia, and its application is limited. Therefore, replicating such a practice will make the technology of satellite data available to a wider community, and help reshape aquaculture in the region.

Moreover, other aquaculture industries may easily adopt accuracy and digital monitoring techniques, which use cutting edge technology to track and control different parts of fish farming operations. Similar attention to feeding schedules, climatic conditions, and water quality might improve production and efficiency in shell farming, which is the cultivation of molluscs, such as mussels and oysters. Likewise, the use of digital monitoring helps to improve water circulation, nutrient levels, and overall system efficiency in aquaponic cultures—which combine hydroponic plant growing with fish rearing. Through the application of these tested methods in various aquaculture contexts, the sector may increase environmental stewardship, profitability, and sustainability.

3. **Project MARRE**, which combines freely available satellite data with in-situ measurements, to create novel solutions to monitor the state of the maritime environment, thus enhancing the existing empirical techniques. As with project AQUASAFE, the use of satellite data is not widespread in Malaysia, therefore replicating practices that utilise remote sensing will assist in eliciting a cost-effective and positive impact on the marine environment through the sustainable management of resources, ecosystem conservation, improved monitoring and enforcement of regulations, support for scientific research, and resilience to climate change.

   Monitoring fisheries is essential for maintaining marine ecosystems, enforcing laws, and promoting sustainable management. It fosters scientific research, provide information for well-informed decision-making, and aids in the prevention of unlawful activity and overfishing. The long-term viability of fisheries across the world depends heavily on fisheries monitoring, which upholds ecosystem health, ensures compliance, and supports livelihoods. Effective monitoring of fishing zones requires cooperation between government agencies, research institutions, non-governmental organisations (NGOs), and fishing communities. Collaborative monitoring initiatives can support sustainable fishing methods, strengthen enforcement capacity, and improve data gathering across the globe.

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4. **Underwater Museum of Alonissos and The Museum of Underwater Sculpture in Ayia Napa, Cyprus (MUSAN)**, which can promote coastal tourism and blue economy in the region. First of all, the idea of underwater museums emphasises the value of cultural heritage by presenting items and historical locations in an unusual and immersive environment. This strategy not only increases public participation but also develops a greater understanding of the connections between the natural environment and human history. This idea may be used to several situations, including terrestrial or urban settings, where historical locations or objects can be incorporated into parks, city squares, or even deserted buildings to revitalise the area and create new cultural hubs.

   Secondly, the creation of underwater museums necessitates cooperation between a range of parties, including local communities, government agencies, conservation groups, and tourism businesses. Through a coordinated strategy that balances conservation efforts with tourist and economic growth, underwater site management is sure to be sustainable. Analogous collaborations may be established in alternative settings to tackle an array of issues, ranging from community development and environmental protection to urban renewal and historical preservation.

   Additionally, new avenues for outreach, teaching, and research are made possible by the creative use of technology in underwater museums, such as virtual reality displays and underwater cameras. These technology developments may be applied in many contexts to improve educational opportunities, encourage scientific inquiry, and increase public awareness of urgent concerns such as social justice, cultural variety, and climate change and biodiversity loss.

   The desire to preserve cultural treasures and make them available to the public is driving the establishment of underwater museums, with underwater archaeology being an emerging field in Malaysia, and particularly in Terengganu. Underwater archaeological sites are exposed to environmental deterioration and the concept of creating such museums and generating an economy based on this could be a new addition to the blue economy sector of the region. However, establishing underwater archaeological would require efforts from the local governments and industries to allow such archaeology-based tourism to be practiced. Then, operators who can establish diving services catering for archaeology-based tourism are needed. Some level of collaboration is also required from academics on knowledge pertaining to archaeology.

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5. **Marine and Environmental Research (MER) Lab**, a small-medium enterprise (SME) of marine scientists, brings together the educational, economic, political, media and environmental helices. MER uses its expert's scientific knowledge and teaching expertise, collaborates with universities, promotes its activities through social media to the wider public, promotes sustainable practices and influences the local government towards promoting the blue economy. The global marine research and conservation community may benefit greatly from the cooperation, innovation, and capacity-building that the MER institute's activities and experiences can provide. Such a practice could be implemented in Malaysia and Indonesia, given that there is already a similar teaching and activities system, focusing on marine and environmental science, with the relevant infrastructure and expertise required to implement similar activities.
6. **Aegean Rebreath (AR)**, formed by a small group of concerned citizens with the goal of protecting the coastal and marine environment, employs a comprehensive circular economy model to address marine ecosystem degradation, acting as a hub, and coordinating cooperative efforts between municipalities, federal agencies, private businesses, and communities. Aegean Rebreath is a living example of environmental democracy that promotes community-based methods of marine conservation. Fundamentally, the group supports methods based on sustainability and transferability, working to implement an all-encompassing model that can be customised for local communities.

   Through its activities, AR hopes to reduce marine pollution, advance blue economy projects, and increase public knowledge of marine conservation. The company prioritises scalability, with institutional and operational approaches created to be replicable at the regional and national levels. The priority of information exchange is a crucial component of this strategy, as it facilitates the sharing of ideas and expertise among communities, so promoting a joint effort towards a sustainable future for our seas. There is also a close cooperation between government agencies and AR. In the context of Malaysia and Indonesia, this practice could be replicated since such a cooperation facilitates matters of bureaucracy, making it easier to expand the cooperation network.
7. **The completion of Maritime Spatial Planning**, at least for important regions in the Partner Countries, similar to that developed in Cyprus in the frame of the MSP 2 project will promote sustainable development in all Blue Economy sectors, such as fisheries, aquaculture, offshore renewable energy, cruise and coastal tourism, etc.

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Below follows a SWOT analysis of the Quintuple Helix practices that have a high transferability potential in the Asian contexts, i.e., in Malaysia and Indonesia:

Practice	Strengths	Weaknesses	Opportunities	Threats
Marine & Environmental Research Lab (MER)	• strong bonds with the government and local stakeholders • reliability • influence on the implementation of local strategies • promotion of good practices in the blue economy	• constraints of funding • sometimes problematic collaboration with external agencies and organisations • autonomy issues, • conflicts of interest • restricted research opportunities	• strong collaborations • long-term monitoring programs • valuable data on ecosystem health, biodiversity trends, and the impacts of climate change and human activities. • public engagement through outreach activities, • citizen science projects • educational programs • raised awareness about marine conservation	• competition with other research institutions • access to funding, talent, and research opportunities • limited resources, expertise, or infrastructure
Blue Municipalities Network (BMN)	• commitment by local authorities and societies • development of best practices • wide network • transparency • innovative practices • acknowledgment at European level	• limited resources • sustained funding	• turning a national network into a European one	• unstable political environment

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Project MARRE	• precision in locating fish populations, • sustainable resource management, • accuracy in production, • enforcement of fishing regulations	• limited data availability • costly mapping and monitoring • specialised technical expertise • challenges in sharing data due to privacy concerns	• enhancement of fishing efficiency and sustainability, • increased market access • profitability, • collaboration among stakeholders, • broader ecosystem management	• risk of overexploitation due to inaccurate maps, • potential conflicts over fishing grounds, • disruption of fish distribution patterns due to climate change
Project AQUASAFE	• accuracy, • efficiency, • real-time monitoring, • automation, • customisation	• high costs, • complexity, • reliability issues, • maintenance, • expertise requirements	• integration with other agricultural technologies, • expansion into new markets, • adoption of sustainable practices	• regulatory changes, • data security, • competition, • market fluctuations, • resistance to change
The Underwater Museum of Alonissos & The Museum of Underwater Sculpture	• unique, immersive experience • preservation of cultural heritage • environmental benefits such as artificial reefs • potential for tourism development. • educational opportunities.	• high initial investment • maintenance challenges • accessibility limitations • environmental impact concerns • safety and risk management issues	• collaboration with stakeholders • technological advancements • diversification of tourism • cultural tourism development • public awareness and engagement	• natural disasters • human activities like looting and vandalism • regulatory hurdles • competition from other attractions • climate change impacts
Aegean Rebreath	• commitment by local authorities and local societies • development of best practices • expanded networks	• limited resources	• development of best practices addressing global challenges • further expanding	• unstable political environment

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	• databases • transparency • innovative practices		practices at European and international level	

Based on the SWOT analysis, the transferability potential of the identified practices to the Asian contexts of Malaysia and Indonesia presents both opportunities and challenges.

The **Marine & Environmental Research (MER) Lab** offers strong governmental and stakeholder connections, making it well-positioned to influence local strategies. Its strengths lie in delivering reliable data through long-term monitoring programs, fostering collaboration between academia, policymakers, and local communities. However, MER's reliance on external funding and occasional difficulties in collaborating with other organizations may hinder its smooth adaptation in Malaysia and Indonesia. Nonetheless, the practice's focus on local stakeholder engagement, citizen science projects, and educational programs makes it highly transferable. These countries could benefit greatly from ecosystem monitoring and involving local communities in conservation efforts.

The **Blue Municipalities Network (BMN)** is another promising model, emphasizing strong cooperation between local authorities and communities. Its strength lies in promoting environmental democracy and transparency in decision-making. Replicating BMN in Malaysia and Indonesia would enhance coastal management and foster collaboration between municipalities. However, the model's reliance on sustained funding and political stability could pose challenges in Southeast Asia. The potential to expand BMN into a broader regional network could significantly contribute to addressing local environmental issues, but it would require overcoming political and financial hurdles.

The **AQUASAFE** and **MARRE** projects, which utilize advanced technologies like real-time monitoring and geoinformatics, offer substantial potential for improving aquaculture and fisheries management in Malaysia and Indonesia. These technologies are valuable in ensuring sustainability, but their high costs, complexity, and the need for technical expertise may slow down their adoption in Southeast Asia. With adequate investment in training and infrastructure, these projects could revolutionize fisheries, making them more efficient and sustainable while aligning with global environmental standards.

The **Underwater Museums**, such as **MUSAN** in Cyprus and the **Underwater Museum of Alonissos**, present unique opportunities for Malaysia and Indonesia to blend cultural heritage with marine conservation. These projects offer a rare combination of environmental protection (by creating artificial reefs) and tourism development. They could boost eco-tourism in regions rich in underwater

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archaeology or biodiversity, providing a sustainable model for tourism that aligns with the goals of the blue economy. However, the high initial investment, maintenance challenges, and potential environmental concerns may pose barriers. Collaboration between local governments, tourism stakeholders, and conservationists will be essential to ensure these museums can contribute both culturally and economically to the region.

In summary, while all practices show potential for adaptation, each comes with distinct challenges. The **MER Lab** and **BMN** emphasize community involvement and governance, making them socially adaptable, while **AQUASAFE** and **MARRE** focus on technological advancements that could drive sustainability in key industries. The **Underwater Museums** provide a cultural and economic opportunity for eco-tourism. Successful transfer will depend on strong stakeholder collaborations, political support, sustained funding, and investments in capacity building to address local needs and challenges in Malaysia and Indonesia.

For the successful adaptation of Quintuple Helix practices in Malaysia and Indonesia, it is very important to incorporate such paradigms to the local context, emphasizing their benefits and enhancing local participation and understanding. The first step for the successful adaptation of any such practice would be to identify the priorities (i.e. education, initial participation) and the aspects that affect the development of the Blue Economy in an Asian context.

Practices that enable higher education to work together to carry out research activities that are closely related to sustainable blue economy can be replicated in the national context of Malaysia and Indonesia. The successful replication of such practices depends on various factors:

- ✓ All relevant stakeholders need to be actively involved, starting with the policy makers (government, local municipalities), first at a local level and later expanding to other municipalities and areas, followed by industry and the education system.
- ✓ Partnerships will have to be developed between government authorities, research institutes and universities, and the private sector stakeholders.
- ✓ Marine research institutions would also need to be positioned as key advisors to the government on marine and coastal management policies.
- ✓ In order to promote transparency and collaboration between all stakeholders, a centralized database could be established for data sharing and storing.
- ✓ A very important aspect for the successful implementation of any new practices is the engagement and participation of local coastal communities, tourism operators, and

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environmental NGOs. This can be achieved through citizen science projects, which will encourage public participation in data collection and monitoring programs and foster a sense of ownership in marine conservation, as well as through outreach activities (workshops, seminars etc.) that will educate local communities on the importance of marine conservation.

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5. Prerequisites and obstacles

When designing the adaptation and replication of the blue-economy practices in the national context of Asian countries, the **local conditions** (political support, infrastructure, environment, economic viability) should be considered. When replicating any blue economy practices, the local social, economic, environmental and cultural conditions should be considered, so that blue economy opportunities and challenges specific to the region will be identified. This will ensure that the blue economy activities designed are consistent with local values and traditions.

Another important prerequisite for the EU best practices to be successfully replicated in Asian contexts refers to the **availability of facilities and resources**, which should be either readily accessible or subsequently attained. It is crucial that steady funding is secured (e.g., from national budgets, international grants, and private sector partnerships) and appropriate funding mechanisms are established, to ensure the long-term sustainability of marine research and conservation programmes and initiatives.

The need for improved **inter-agency coordination** in Malaysia and Indonesia, particularly in managing overlapping policies related to marine resources, is a critical prerequisite for successfully replicating blue economy practices. Both countries face challenges with fragmented governance, making it essential to streamline efforts between national and regional authorities to foster cohesive blue economy strategies (Azam et al., 2023; Zuzy, 2023).

Skilled human resources should be developed, by improving access to higher education and specific training, and by encouraging the active participation of local communities in blue economy activities. Further, **dedicated research** and the development of **innovative technologies** will improve knowledge and support blue economy activities, while also promoting knowledge transfer to the local communities. In order to successfully replicate any practices, **appropriate infrastructure** should be developed, and appropriate technology should also be transferred and applied to help improve efficiency and productivity and support all activities. Access to capital and financing for blue economy activities should also be improved.

Another important factor to be taken into consideration when attempting to adapt and replicate practices from the EU to the Asian contexts is the ability to adapt them to the **varying environmental conditions and challenges** (e.g., climate change), by developing new innovations and solutions that

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also address the challenges of the blue economy. This will ultimately aid in increasing the resilience and sustainability of blue economy activities in these contexts.

Furthermore, it is essential that **a strong collaboration** is built among stakeholders, including governments, the private sector and civil society. The development of effective and **transparent governance** will ensure the sustainability of blue economy activities and the protection of marine and coastal resources. Policies and regulations that support the development of blue economy practices should be consistent with sustainable development goals.

The **involvement of local communities in decision-making processes** related to the blue economy will ensure that the benefits of blue economy activities are shared within them, which will subsequently raise their feelings of empowerment and ownership. Finally, collaborating with other countries by **participating in international forums and supporting global efforts** to protect oceans and coasts will aid in sharing knowledge, experience and technology related to the blue economy, and open opportunities for funding.

Possible obstacles for the implementation of blue economy practices in Malaysia and Indonesia could include resource constraints, lack of expertise and policy support. More specifically, the following problems could be encountered:

- Hesitation from involved stakeholders in adapting new technology for application in the local context.
- Issues of sustainability and finances, i.e., will the generated output cover the implementation costs, as well as limited funding opportunities.
- A change in the leadership of local authorities may hamper or even negate the completion of projects that are in progress or ready to commence. Further, political and economic uncertainty can discourage stakeholders from investing in blue economy activities.
- Lack of coordination between government authorities that can lead to inefficiencies and overlaps in the program implementation.
- Limitations in the availability of technical expertise and access to advanced technologies necessary for the implementation of these practices.
- Threats that may impact or destroy the local marine and coastal ecosystems can impact the successful replication of practices. Such threats include marine pollution, overfishing, and

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climate change. Weak law enforcement against illegal activities could lead to harmful impacts on the marine and coastal environment.

- The lack of public awareness on the importance of marine ecosystems, which can hinder the efforts of replicating blue economy practices.
- Limited resources, such as relevant expertise and technology, which can hamper the development of practices.

Other significant obstacles might include the heavy reliance on extractive industries in both countries. Despite commitments to sustainable development, sectors like oil and gas still dominate the economy, making it challenging to fully transition to blue economy practices. In Indonesia, for instance, this reliance on extractive sectors conflicts with sustainable blue economy goals, requiring a delicate balance between industrial interests and environmental protection (World Bank, 2021; Zuzy, 2023)

Additionally, infrastructure gaps pose another hurdle. Coastal areas, particularly in rural regions, often lack the technological and logistical support needed to implement advanced blue economy initiatives, such as marine monitoring systems or precision aquaculture. Addressing these infrastructure gaps requires significant investment in technology, training, and public-private partnerships (Martínez-Vázquez et al., 2021).

Finally, climate change presents an overarching challenge, with rising sea levels, tidal flooding, and coastal erosion threatening the sustainability of marine and coastal economies in both countries. These environmental factors complicate efforts to maintain and protect ecosystems while pursuing economic growth (Azam et al.,2023; Zuzy, 2023).

All the above obstacles and problems could be overcome by firstly gaining the support of local authorities and other relevant stakeholders, by demonstrating success stories from Quintuple helix models applied elsewhere. Another important aspect will be to raise awareness on blue economy practices and how they can improve local economy, as well as ensure adequate training that will enable local stakeholders to adapt to the new practices and technologies. Addressing these issues requires holistic approaches, integrating policy reforms, technological advancements, and stronger regional cooperation.

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6. Conclusions

The SustainaBlue project represents a significant opportunity to enhance the sustainable blue economy in Malaysia and Indonesia by leveraging successful European Quintuple Helix practices. The project's core goal is to boost the relevance of Higher Education Institutions (HEIs) to the labour market and society by addressing key issues such as environmental sustainability, workforce skill gaps, and local economic development.

Drawing from successful European practices, several models that are well-suited for replication and adaptation in the Asian context have been identified. For instance, the Blue Municipalities Network (BMN) demonstrates the strength of regional cooperation, bringing together local authorities, academia, and private sectors to address environmental concerns while promoting sustainable tourism and economic activities. This model is particularly relevant to Malaysia and Indonesia, both of which have significant coastal communities, and its replication could empower coastal municipalities to collaborate on marine environmental issues, promoting sustainability while also fostering local economic growth.

Another standout practice is the Marine and Environmental Research (MER) Lab, which bridges education, policy, and marine science research. By providing both consulting services and educational programs, MER fosters a close link between scientific research and policy-making. A similar structure in Malaysia and Indonesia could greatly benefit local marine ecosystems by improving scientific research capacities, strengthening government advisory roles, and creating educational opportunities that enhance the skills of local labor forces. Given that both countries face significant marine biodiversity challenges, a well-established marine research center could lead to better-informed policies and greater stakeholder involvement in environmental conservation.

Technological innovation, as seen in the AQUASAFE and MARRE projects, is also a vital component of replication. AQUASAFE's use of geoinformatics for aquaculture monitoring and MARRE's integration of satellite data for maritime environmental monitoring demonstrate the critical role that technology plays in the modern blue economy. For Malaysia and Indonesia, where the aquaculture and fisheries industries are important economic drivers, the application of these remote monitoring and data analysis systems could revolutionize current practices. Not only would they allow for better resource management and early warning systems for environmental hazards, but they would also enhance productivity and sustainability in aquaculture, aligning these industries with global standards for sustainable practices.

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Underwater Museums, such as MUSAN in Cyprus and in Alonissos, Greece, also offer a replicable model for coastal tourism that merges cultural heritage with marine conservation. In Malaysia and Indonesia, where tourism is a vital economic sector, this model could boost eco-tourism, particularly in regions rich in underwater archaeology or vibrant marine life. Such initiatives would require collaboration between local governments, conservation experts, and tourism stakeholders to develop attractions that preserve natural and cultural heritage while promoting responsible tourism.

Adapting these practices will, however, require overcoming several challenges. The most significant of these include limited technical expertise, inadequate infrastructure, and potential hesitation from stakeholders to adopt new technologies. Successful adaptation will depend on building strong partnerships between government authorities, HEIs, industries, and local communities. Capacity-building will be essential, particularly in training stakeholders on new technologies like satellite-based monitoring and precision aquaculture. Moreover, sustained funding mechanisms, whether through national budgets or international grants, will be critical to ensure the long-term viability of these initiatives.

It is also important to recognize that the socioeconomic conditions of Malaysia and Indonesia differ from those in Europe, which means that replication should not be a one-to-one process. Adaptation efforts must consider local cultural values, environmental contexts, and existing governance frameworks. For instance, blue economy practices may need to be tailored to address specific environmental threats in the region, such as overfishing or coral reef degradation, while also accounting for local governance structures and community involvement. Practices like Aegean Rebreath, which foster community-based marine conservation, offer a model for involving local communities in conservation efforts. Replicating such initiatives in Southeast Asia would enhance public awareness and empower local communities to take active roles in protecting marine ecosystems.

Ultimately, the SustainaBlue project lays the groundwork for transformative changes in the sustainable blue economy in Malaysia and Indonesia. By facilitating the adaptation of successful Quintuple Helix models, the project will not only advance environmental conservation and economic development but also foster greater collaboration among diverse stakeholders. The replication of these practices will strengthen the capabilities of HEIs, improve the employability of students, and provide critical support to local industries, thus creating a more resilient, inclusive, and sustainable blue economy in both countries.

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7. References

Azam, A. H. M., & KV, M. R. (2023). *Malaysia's Blue Economy: Position, Initiatives, and Challenges* (No. PB-2023-04).

Carayannis, E. G., Barth, T. D., & Campbell, D. F. (2012). The Quintuple Helix innovation model: global warming as a challenge and driver for innovation. *Journal of innovation and entrepreneurship*, *1*, 1-12. https://doi.org/10.1186/2192-5372-1-2

Carayannis, EG, & Campbell, DFJ (2010). Triple Helix, Quadruple Helix and Quintuple Helix and how do knowledge, innovation and the environment relate to each other? A proposed framework for a trans disciplinary analysis of sustainable development and social ecology. *International Journal of Social Ecology and Sustainable Development, 1*(1), 41–69. http://www.igi-global.com/bookstore/article.aspx?titleid=41959

Martínez-Vázquez, R.M., Milán-García, J. & de Pablo Valenciano, J. (2021). Challenges of the Blue Economy: evidence and research trends. *Environ Sci Eur 33,* 61. https://doi.org/10.1186/s12302-021-00502-1

World Bank (2021). Oceans for Prosperity: Reforms for a Blue Economy in Indonesia. The World Bank, Washington, D.C.

Zuzy, A. (2023). Unlocking Indonesia's Potential Through A Blue Economy. CodeBlue. Retrieved from https://codeblue.galencentre.org/2023/06/15/unlocking-indonesias-potential-through-a-blue-economy/ on 06/09/2024.

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